Plans for xGW manufacturing in Europe

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and
Albert Ludwigs University, Freiburg

EU PV Platform,
Brussels, June 24, 2014

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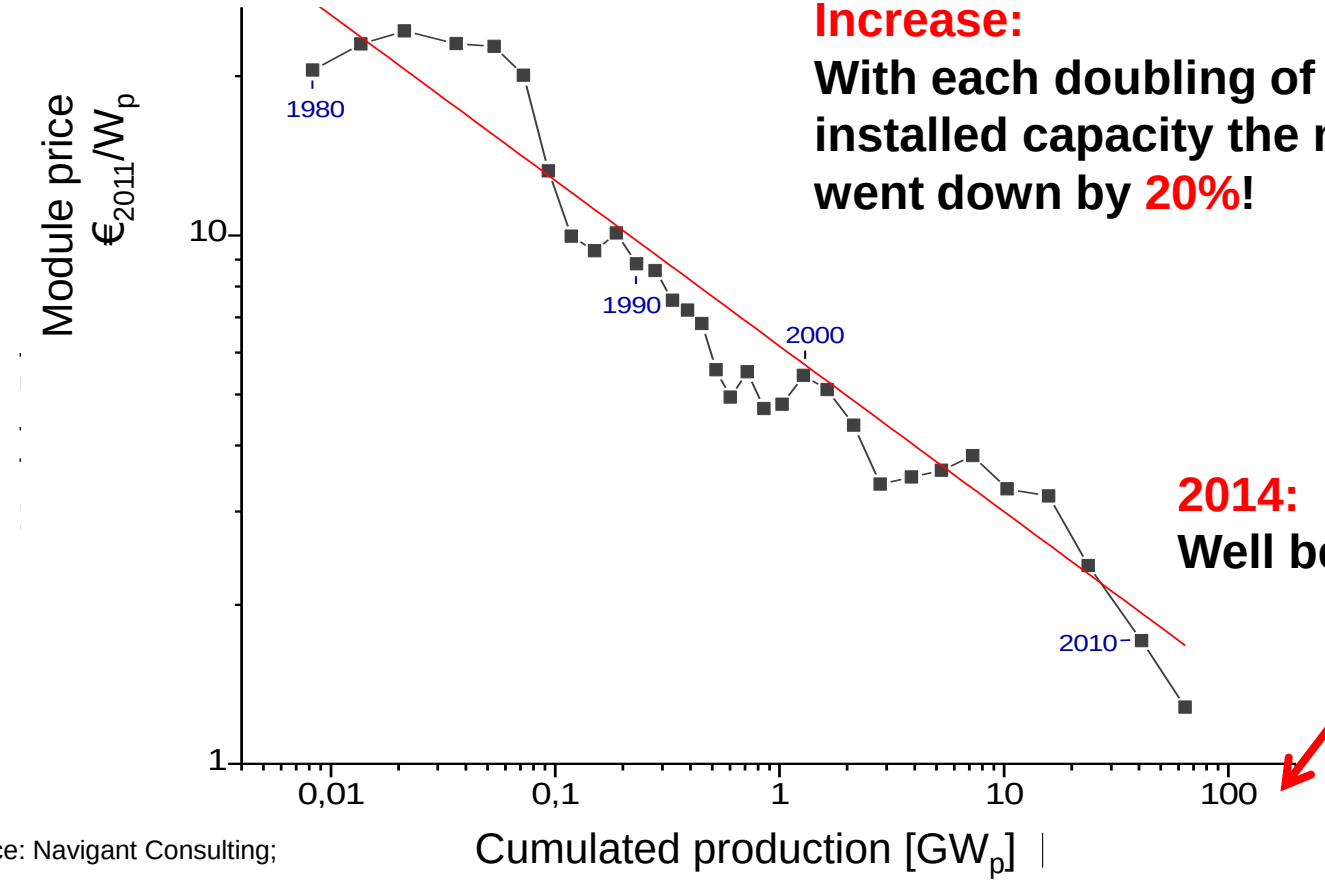
PV learning curve (all c-Si PV technologies)



Increase:
With each doubling of the globallly installed capacity the module price went down by 20%!

2014:
Well below 1€/W_p!

Source: Navigant Consulting;
EuPD Module price (since 2006); Design: PSE AG 2012

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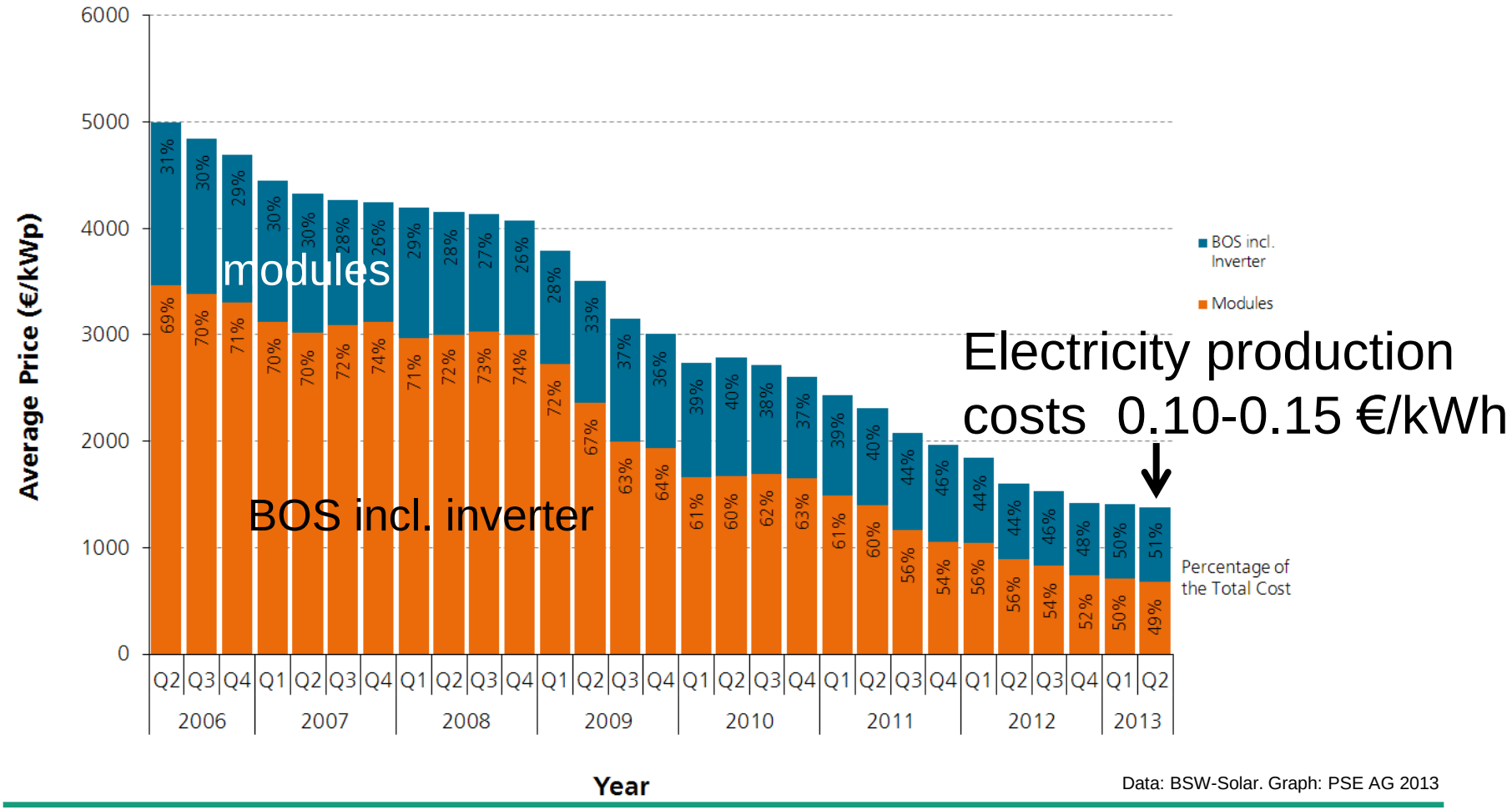
Average price of rooftop installations in Germany (10kWp - 100kWp)



Data: BSW-Solar. Graph: PSE AG 2013

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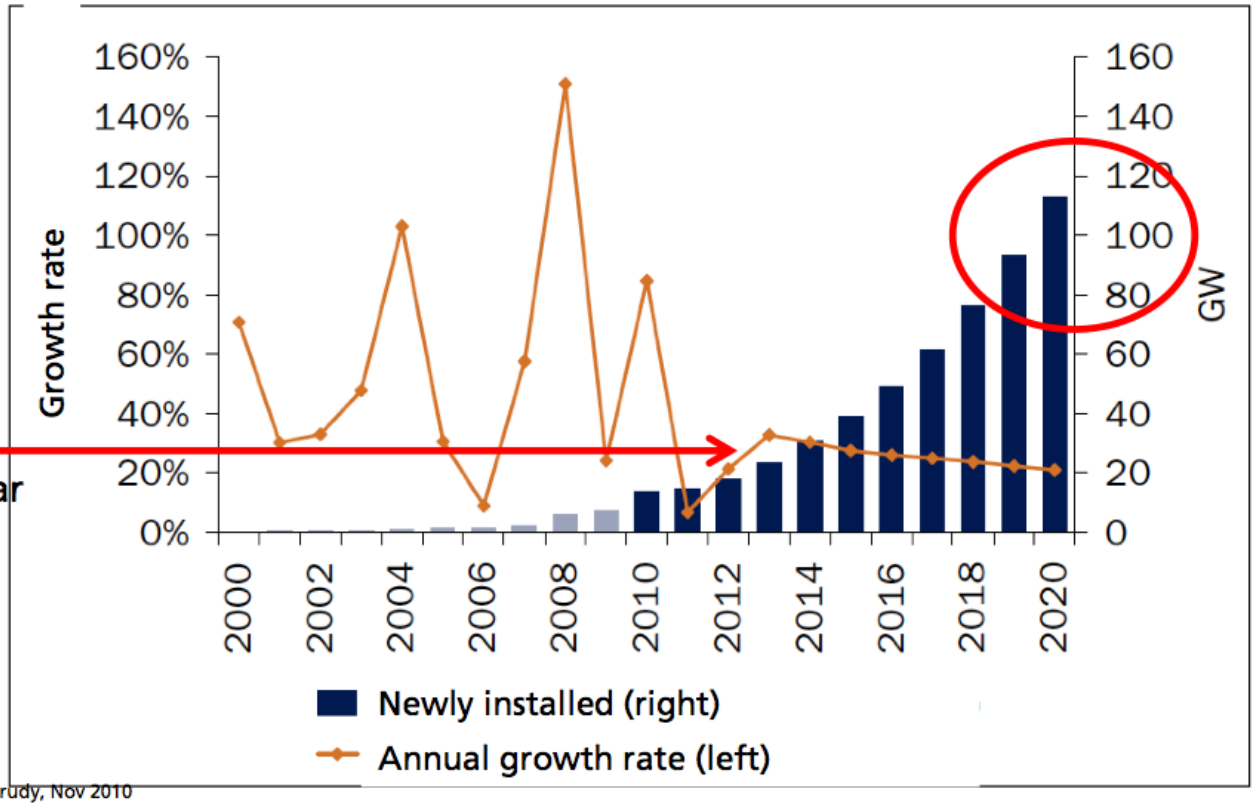
World market outlook: Experts are optimistic
Example Bank Sarasin, Nov. 2010

- **Market forecast: 30 GW_p in 2014, 110 GW_p in 2020**
  Annual growth rate: in the range of 20% and 30%

2012:
With 30 GW_p far above forecast, 2013: 37 GW expected!



5 Source: Sarasin, Solar Strudy, Nov 2010

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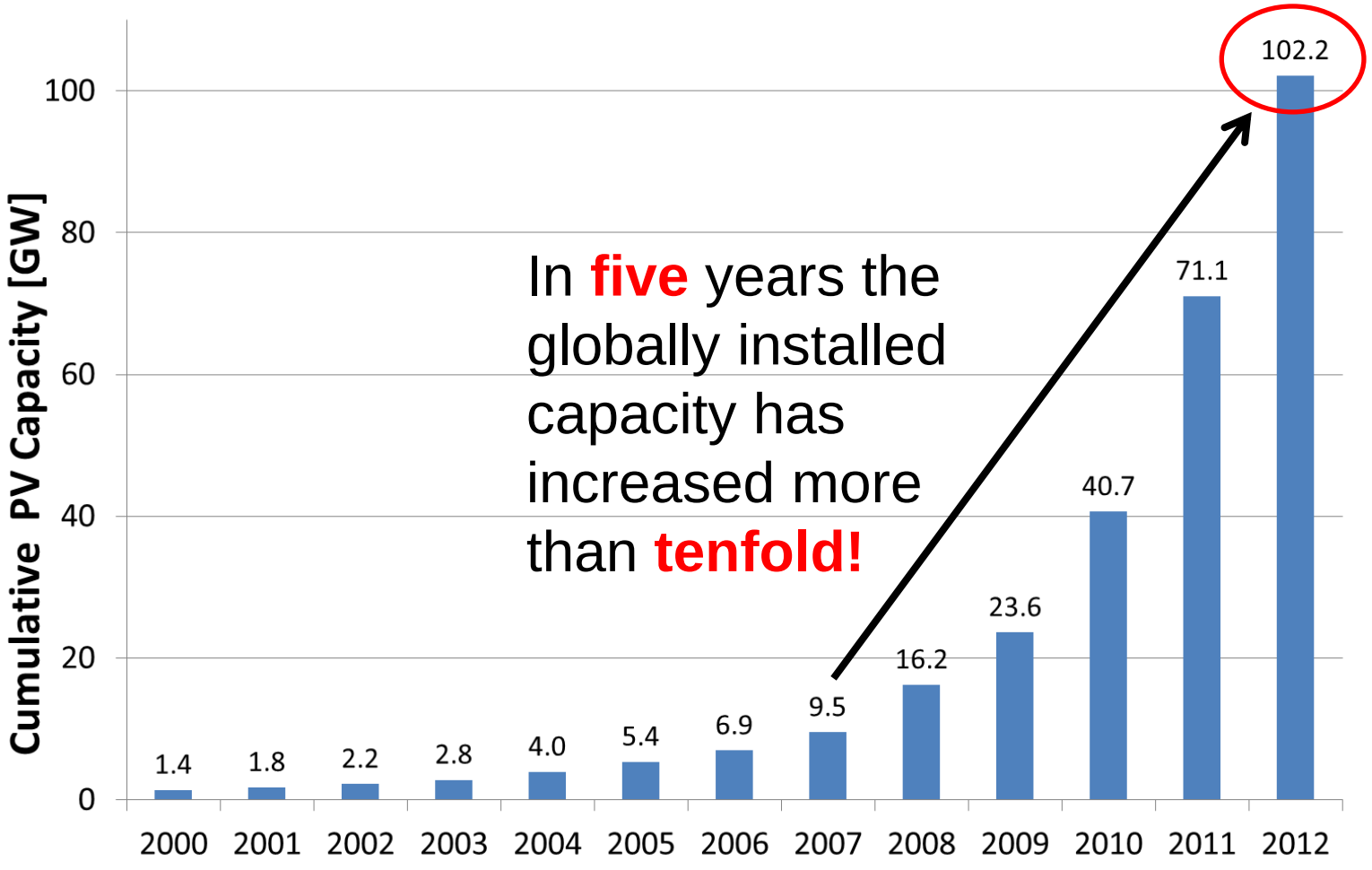
The interest in Photovoltaics is increasing worldwide

Cumulated global capacity, until end 2013 ca. 140 GW installed



Quelle: EPIA, Global Market Outlook for Photovoltaics 2013-2017, May 2013

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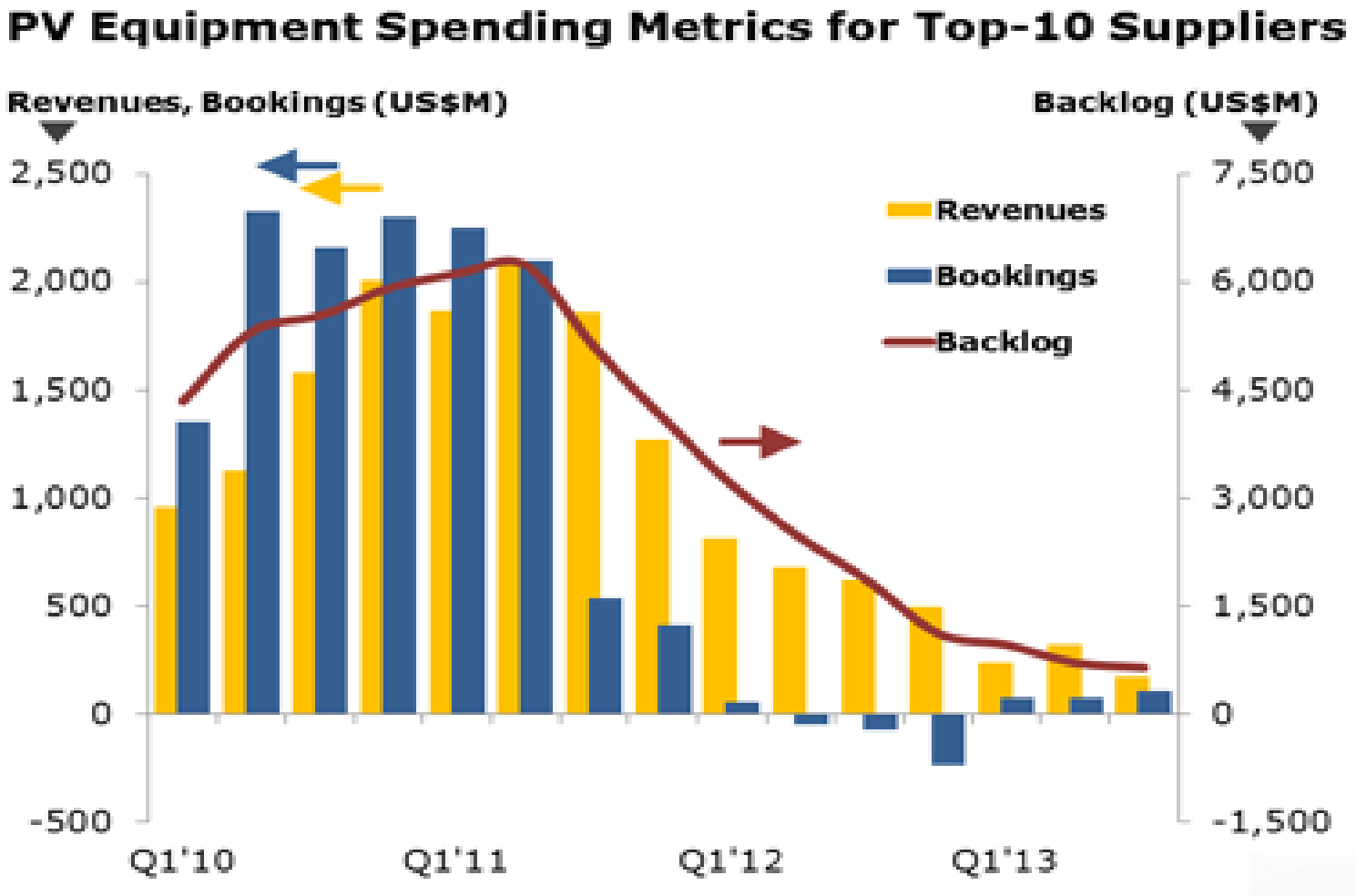
Dangerous crisis also for PV production equipment manufacturers



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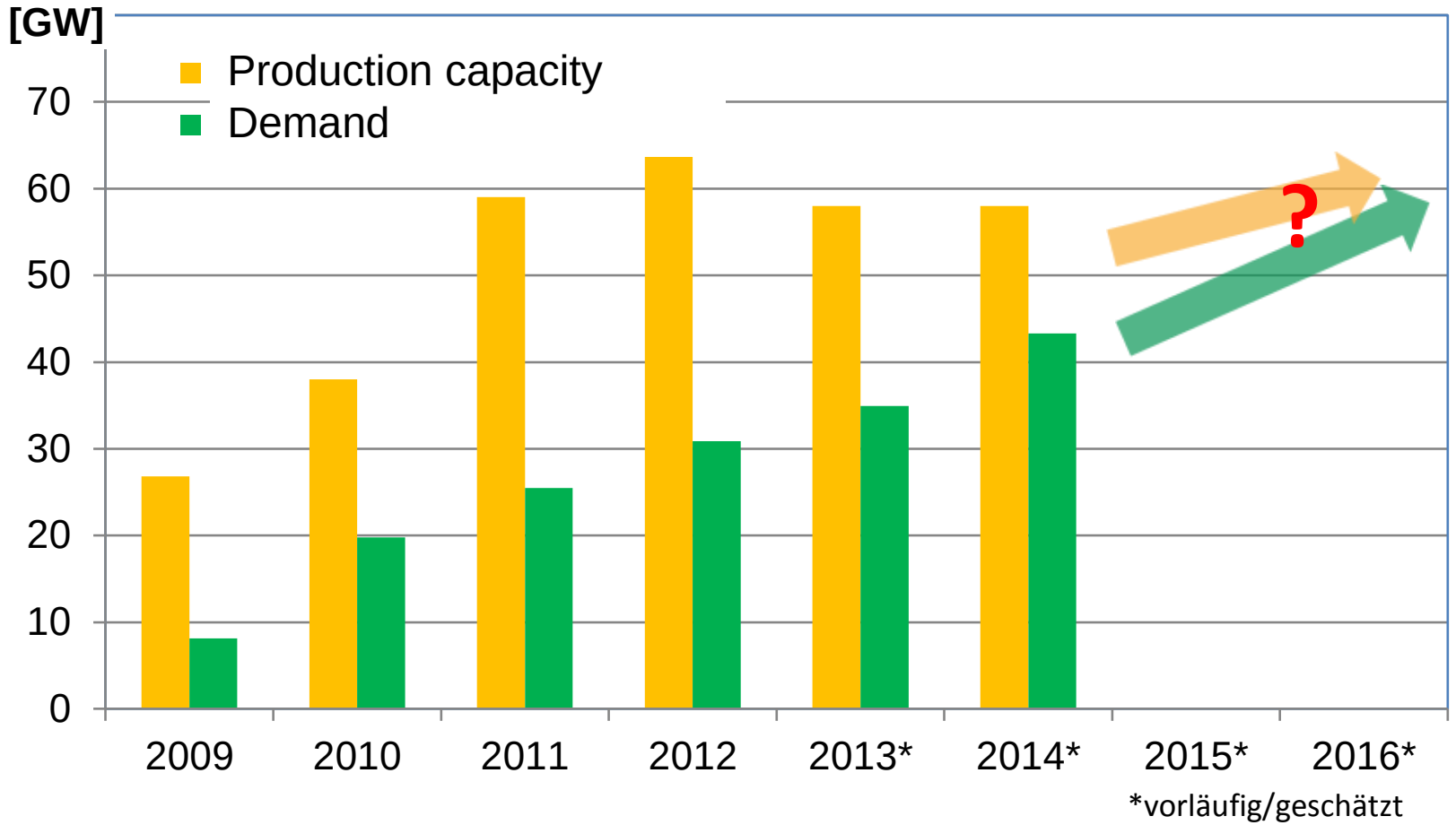
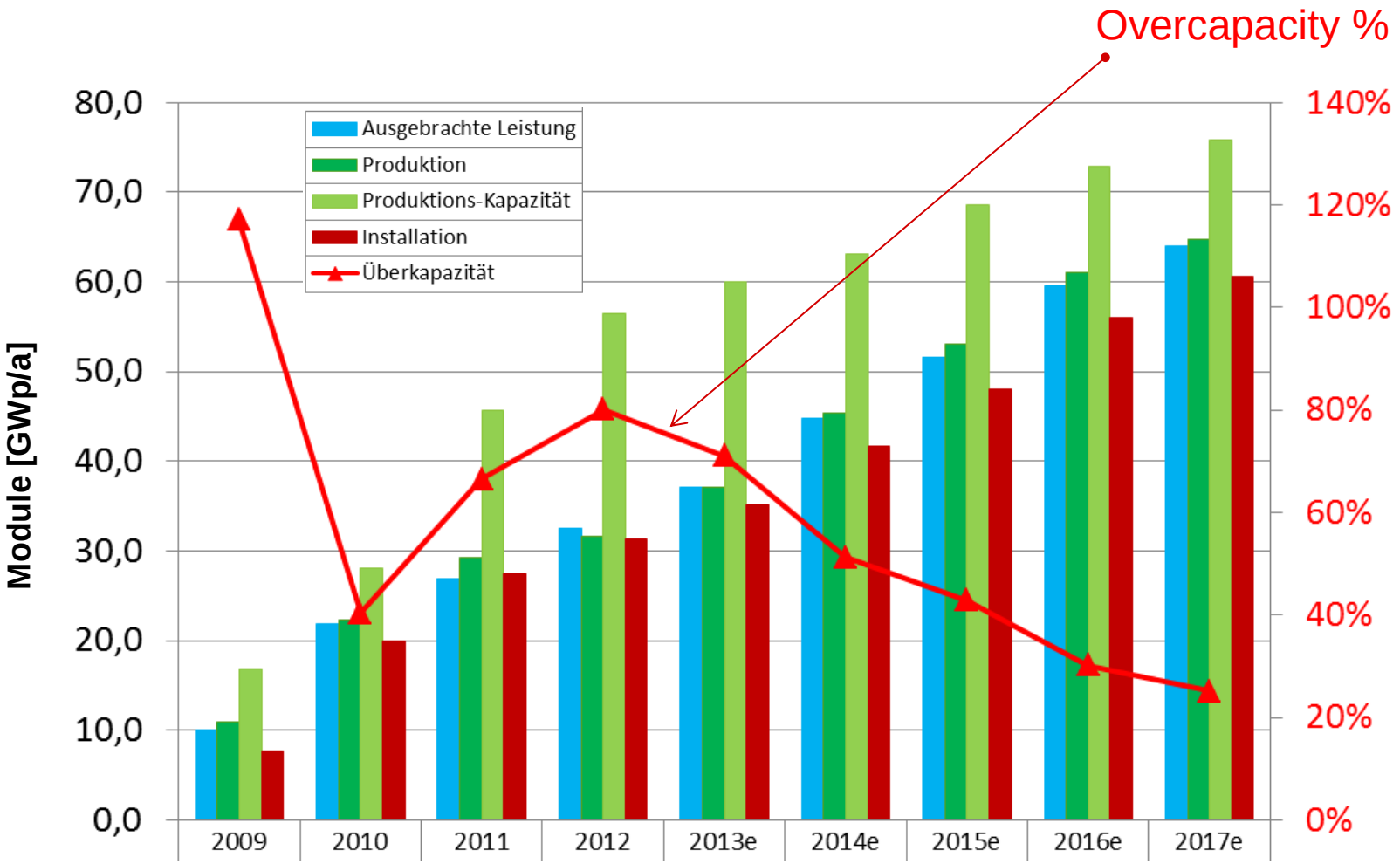
The Gap between global PV Production Capacity and Sales is Closing!



- **Non-competitive PV fabrication lines are closing worldwide**
- **Demand > 50 GW 2015 might result in shortage of PV modules!**

Slide courtesy Tobias Kelm, ZSW; data from EPIA, Mercom, iSupply, BNEF, IEA, Photon, SW&W, Bloomberg, Solarbuzz, and own estimates

Analysis PV Market – Capacity / Production → 2017 (Forecast: IHS)



Quelle: IHS; Graph: PSE AG

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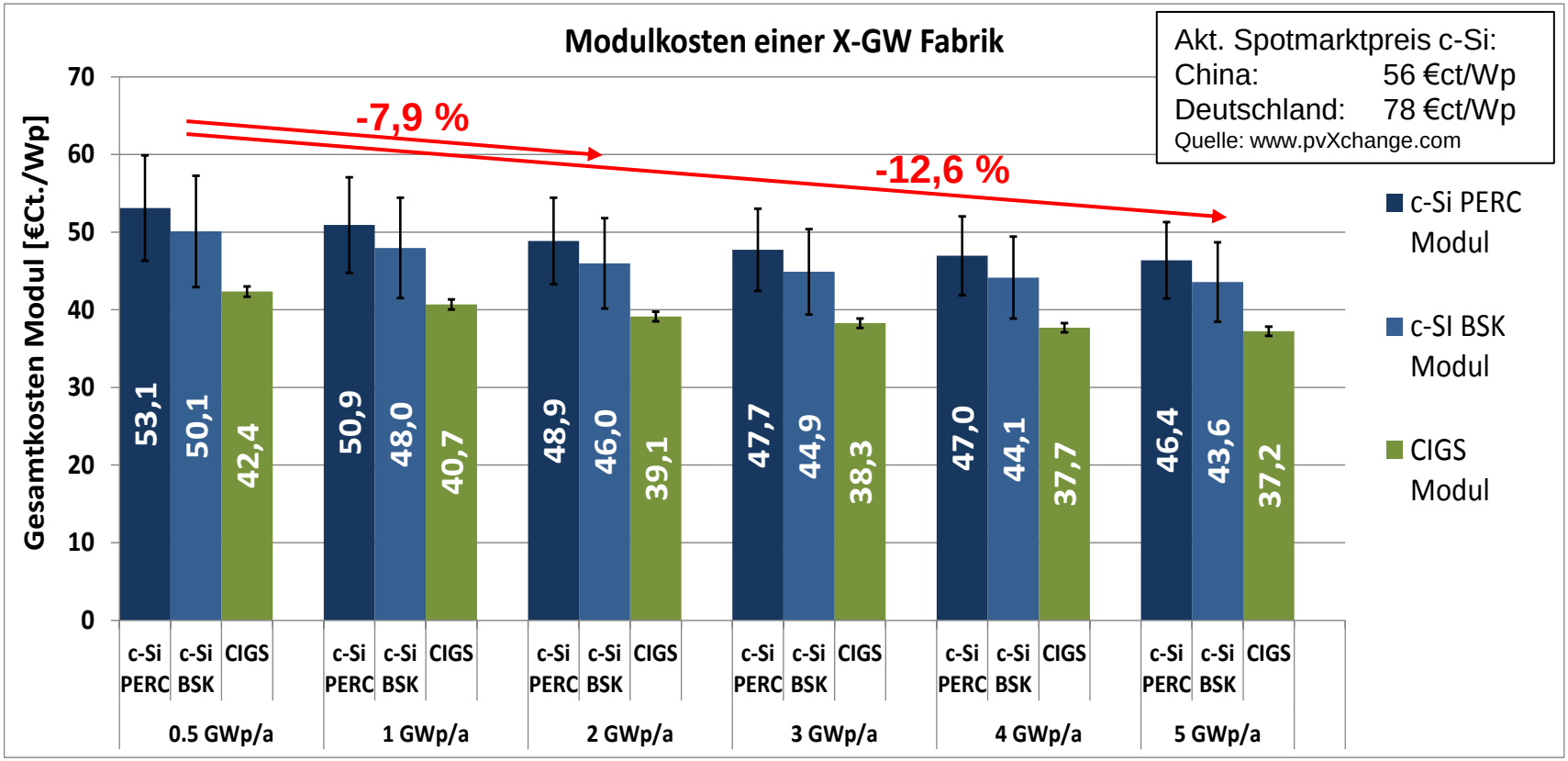
Results X-GW of module production cost analysis for Baden-Württemberg (Fraunhofer ISE + IPA 2013)



Cost reduction due to material and equipment cost effects

Additional potentials due to scale effects in the production not included

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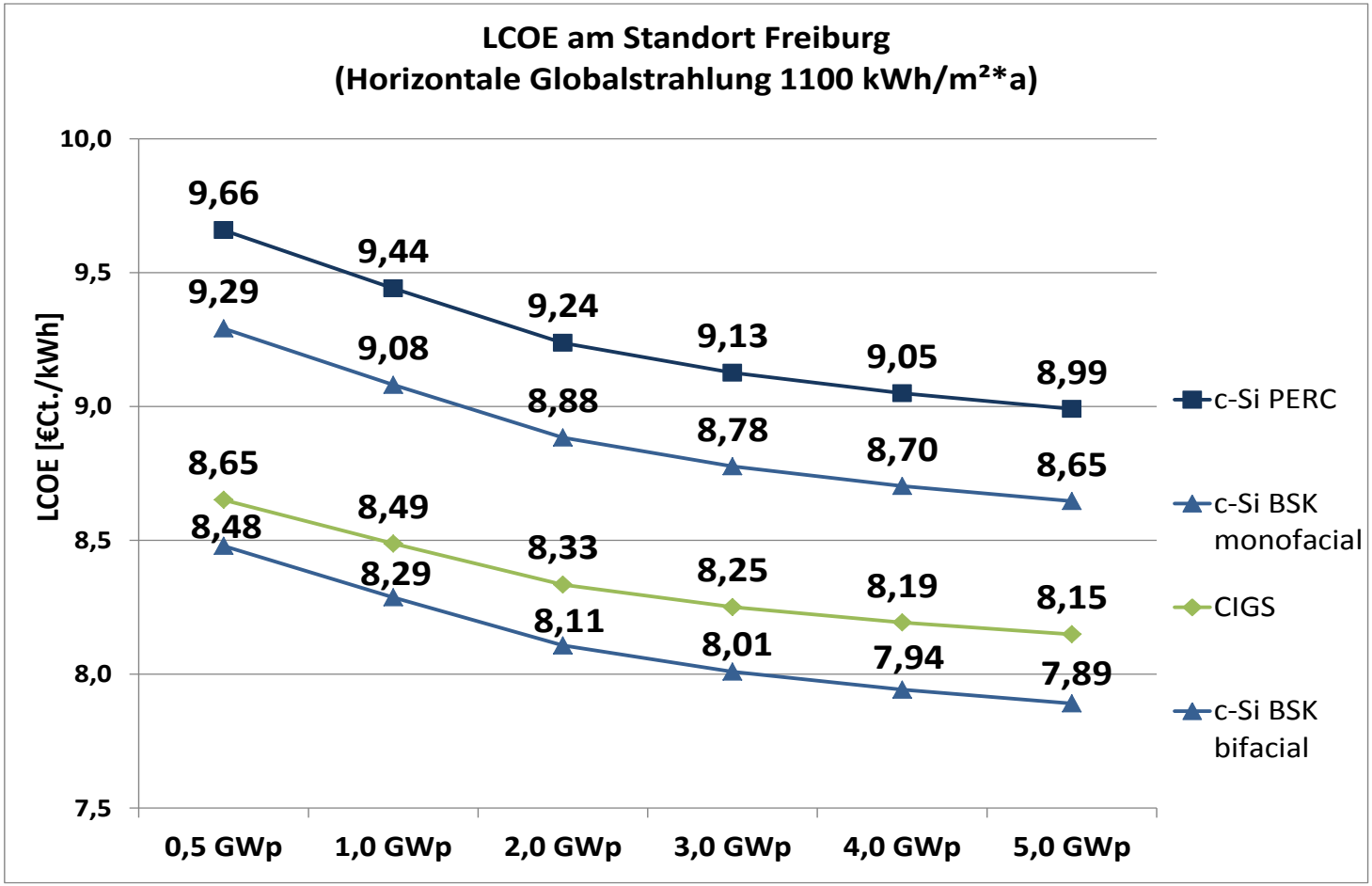
Results X-GW production cost analysis for BaWü: LCOE dependence on Fab size



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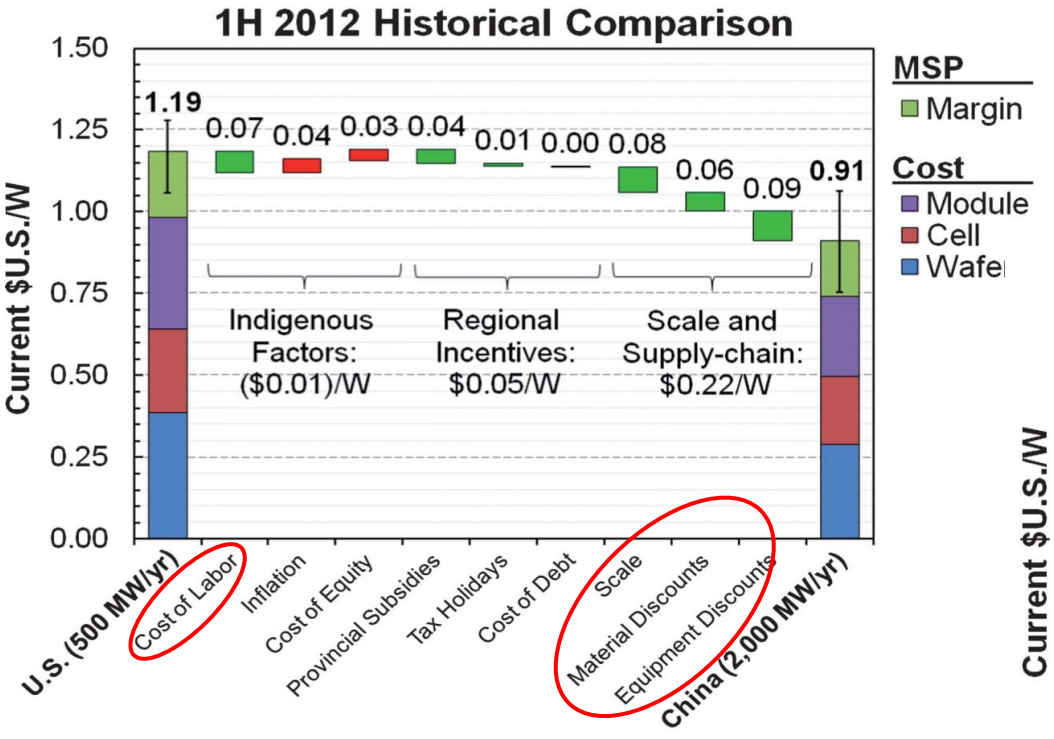
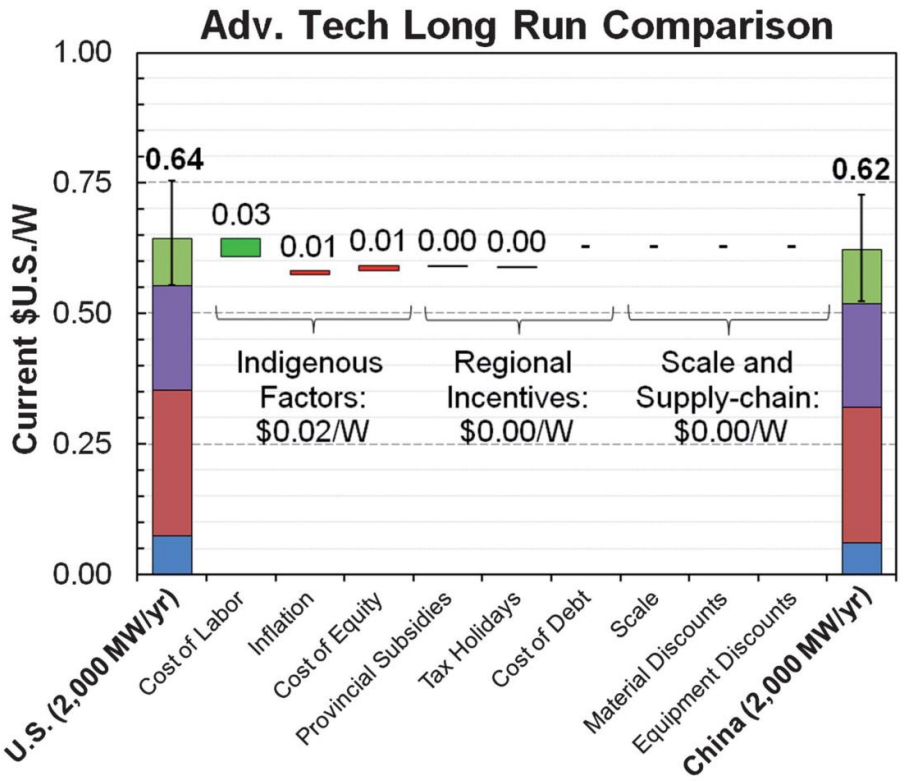
Goodrich 2013: Cost comparison USA / China





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The Challenge

BASIC CONDITIONS

1. Cell technology of the next generation
2. Highly automated integrated production
3. High production volume > 1GW$_p$

DYNAMICS

- Be ready when new capacities are needed: 2017/18
- Maintain high innovation speed

THINK IN SYSTEMS

- Optimise the use of photovoltaics in energy and building systems
- Optimise the production system across the value chain and production networks
- Translate high European system competence in added value

xGWp: Research institutes and industry partners react to the PV crisis

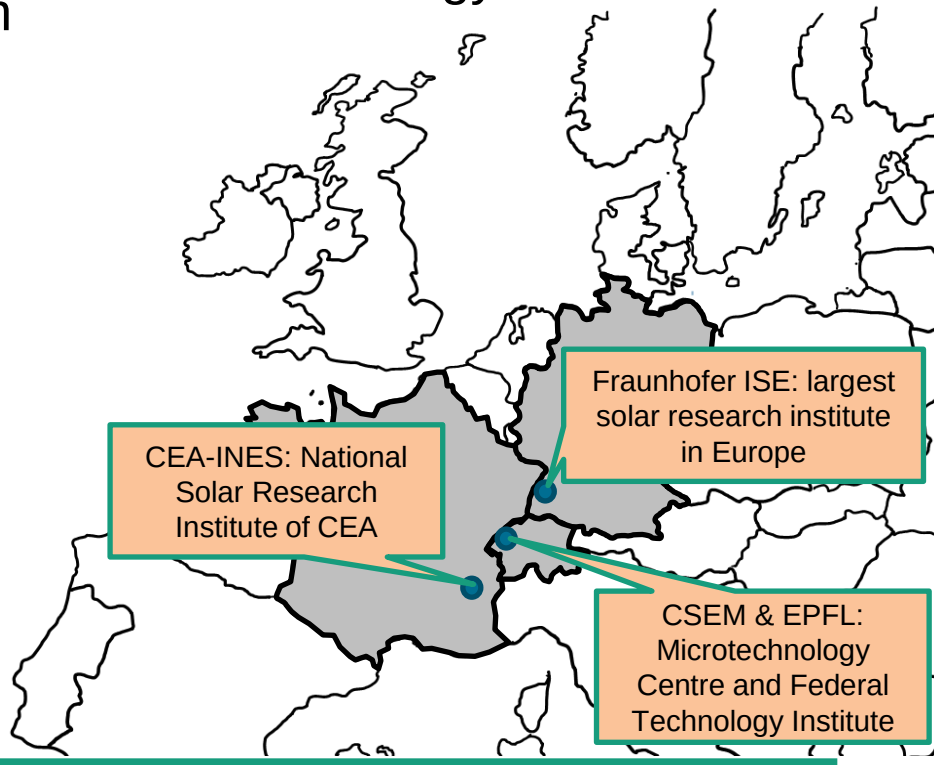
xGWp
European Gigawatt Fab

Crisis of the solar industry:
Missing manufacturing of cells and modules now also threatens research and suppliers in Europe

Leading research institutes and industrial partners take the initiative to build a European Gigawatt Fab with new technology

↓ Research institutes	international
↓ Manufacturers of production plants	international
↓ Banks and financing companies	can be local
↓ Manufacturers	
– silicon	international
– wafers, cells	international
– modules	can be local
↓ Traders	can be local
↓ System integrators, EPC contractors	can be local
↓ craftsmen in the construction business	local
▪ operating company	can be local

Gigawatt Factory



www.xGWp.e

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xGWp European Gigawatt Fab

xGWp
European Gigawatt Fab

Objectives

- Establishing a Gigawatt-size **PHOTOVOLTAIC** cell and module factory with next generation technology in Europe, full capacity 2017/2018
- Proving industrial production readiness with a 100MW demonstration line, later to be used as pilot line for further development
- Long-term close cooperation of leading companis and research institutes
- 2014: company, 2015: 0,1 GW_p demo line, 2018: 1 GW_p fab

Progress beyond the state-of-the-art

- Combining advanced Si-based cell with innovative contacting and other technologies in automated, lean production processes in GW-scale
- Achieving high efficiency cells (22→25%) at low prices
- Favourable characteristics leading to unprecedented low electricity generation costs
- Consistent further cost reduction through continuing innovation (roadmap)

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xGWp Innovation

xGWp
European Gigawatt Fab

VISION: European PV system industry as column of European energy transformation and competitiveness

- European cooperation
- Motor: Germany & France
- European innovation network

Political innovation

PV: component of smart systems
- Innovation in industrial network
- Close partners downstream & upstream
- New business models

Business model innovation

- leading research institutes directly involved
- Permanent high level of innovation

Entrepreneurial innovation

Cheaper Solar Power
- Higher efficiency
- Lower costs
- Better characteristics

Product innovation

- Less material needed
- Less process steps
- Higher automation
- Higher quality

Process innovation

Technical innovation

- Not yet disclosed

VISION: Disruptive PV with next technology generation

Combining experiences: PV silicon technology, microeletronics, nanotech

www.xGWp.eu

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Deutsche Bank
Markets Research

Date
6 January 2014

Industry Update

Let the Second Gold Rush Begin

Demand Could Continue to Surprise to the Upside

While we have been generally constructive on the global demand outlook, we are raising our 2014 and 2015 demand expectations from 44.5 to 46.1GW and from ~52 to ~56GW respectively. We believe upside demand surprises from the US, Japanese and Chinese markets could continue in 2014. We expect a combination of streamlined incentive programs in China, additional subsidy cut signals in end 2014 and decreasing financing constraints to act as catalysts for upside demand surprises. While these 3 markets showed the most upside relative to expectations in 2013, we expect many more international markets to become meaningful growth contributors from 2014. Specifically, we expect India, South Africa, Mexico, Australia, Middle East, South America and South East Asia to all act as strong growth contributors. The majority of these markets are at grid parity and as such sustainable. Moreover, we believe some of the grid and financing constraints that have inhibited growth so far are set to improve in 2014.

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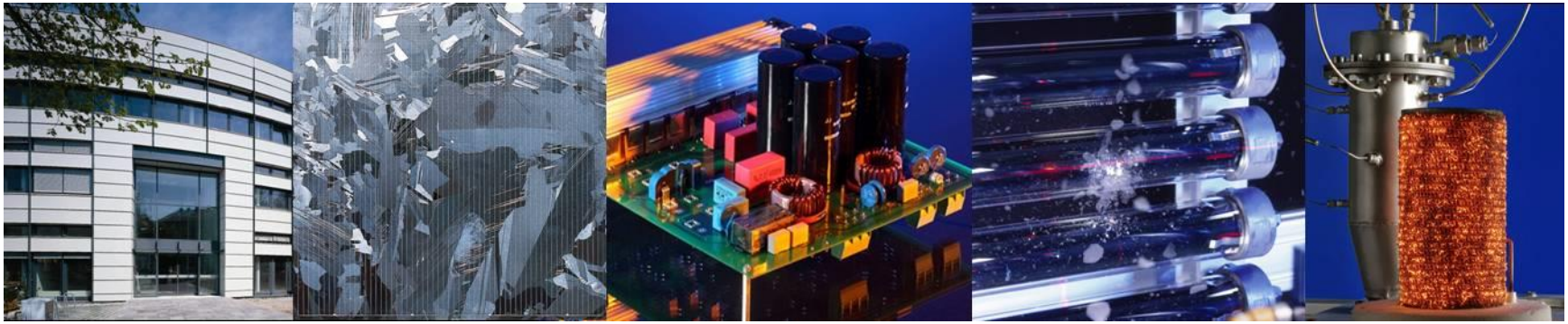
Thank you for your attention!



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